

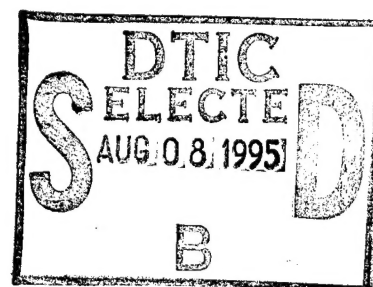
Simulation and Training for Stress Environments: A Meta-Analytic and Experimental Evaluation

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for

**Contracting Officer's Representative
George Lawton**

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13. ABSTRACT (Maximum 200 words) A vast amount of research on stress and training has been conducted in the past several decades. This research identifies approaches that are potentially effective for stress training, but often produces conflicting results that are difficult to interpret at the narrative level. It also describes a series of meta-analytic studies undertaken as part of a research project to integrate and summarize the research literature on stress training. The technical approach examined those training approaches that the research literature suggests may be effective for enhancing performance under stress, including overlearning, mental practice, stress inoculation training, cohesiveness, team building, and relaxation training. This approach provided the opportunity to gauge, on a quantitative basis, the overall effectiveness of alternative training approaches. Second, it allowed the identification of factors that moderate the effectiveness of these training approaches to determine the most effective means to implement a specific training approach. Finally, this strategy provided precise direction for further research and application.				
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SIMULATION AND TRAINING FOR STRESS ENVIRONMENTS: A META-ANALYTIC AND EXPERIMENTAL EVALUATION

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SIMULATION AND TRAINING FOR STRESS ENVIRONMENTS: A META-ANALYTIC AND EXPERIMENTAL EVALUATION

A. Research Objectives:

The purpose of this research was to evaluate the effectiveness of candidate stress training approaches for application to the military environment, and to identify specific guidelines for implementing these techniques to enhance the performance of military personnel.

B. Summary:

The problem that we have addressed in this research project is how to identify effective training approaches to enhance the performance of military personnel under high-stress conditions. The importance of "stress training" to the military was identified as early as World War I, and a large amount of research has been conducted since that time examining training approaches to reduce the effects of stress on performance. This research has identified a number of approaches that are potentially effective for stress training, but the research has often produced conflicting results that are difficult to interpret at the narrative level.

Imagine the following scenario. A military program manager asks you the following questions: "I read that an approach called stress inoculation training may be an effective stress training technique, but I also came across some research that showed no positive effects. Is this training approach effective? Furthermore, will it work in a military environment? Is the training so complex to implement that I need a Ph.D-level trainer, or can I use less experienced trainers? How many hours of training are required to enhance performance? If it takes 40 hours of intensive training to produce positive results, it won't be of much use in applied settings. Can you give me some answers?"

There are several different ways you could attempt to answer these questions. First, you could conduct an empirical study of the effectiveness of stress inoculation training. Experimental research is the backbone of the scientific enterprise; however, the results of a single study are rarely conclusive and often conflict with other available data. Second, you could conduct a traditional literature review and attempt to weigh the evidence from most available studies. However, because different studies are conducted in different settings, use different outcome measures, and report different study statistics, it is difficult if not impossible to summarize these disparate research studies on a narrative level in order to draw specific conclusions. A third approach is to attempt to integrate and summarize research results using a meta-analytic statistical technique. This approach uses a powerful statistical technique to summarize data from existing studies in a systematic and quantitative manner in order to provide specific answers to research questions.

The approach taken in this project was to conduct a meta-analytic integration of the research on stress training. Our strategy was to examine those stress training techniques that the research literature suggests are potentially effective, and that are also of interest to the military community, such as overlearning, mental practice, and stress inoculation training. This approach allowed us the opportunity to gauge on a quantitative basis the overall effectiveness of alternative approaches. Second, it allowed us to identify factors that moderate the effectiveness of these training approaches, in order to determine the most effective means to implement a specific approach. Finally, this strategy provides precise direction for further research and application.

The Meta-Analytic Approach

It is informative to provide a distinction between primary analysis, secondary analysis, and meta-analysis. Primary analysis refers to the original statistical analysis of data; for example, the analysis of data collected by a researcher examining the effects of overlearning on retention. Secondary analysis refers to analysis of data by someone other than the original investigator. For example, investigator B may re-analyze investigator A's data on the effects of overlearning, to examine a particular variable of interest. Meta-analysis refers to the analysis of the results of several independent studies. For example, if investigators A through Z have conducted 20 studies of the effects of overlearning on retention, a meta-analysis would provide a quantitative summary and integration of the results of these separate studies.

Meta-analysis allows the results of a number of independent studies to be analyzed, compared, and summarized. For example, a number of studies have examined the effects of mental rehearsal or mental practice on performance. Some researchers have found positive effects of mental practice, while others have found no significant effect. It is difficult to make a confident prediction about the effectiveness of mental practice because of the variability of research findings and the variety and types of data reported in these different studies. Glass (1976) concurs that "The accumulated findings of [independent] studies should be regarded as complex data points, no more comprehensible without statistical analysis than hundreds of data points in a single study" (p. 352).

The meta-analytic approach presents the opportunity to do two very useful things. First, it can provide a very specific and precise summary of the overall effects within a given research domain (i.e., Is mental practice an effective means of enhancing performance?). For example, by analyzing each study that has examined the effects of mental practice on performance, we can provide summary statistics indicating the overall magnitude and significance of this effect. Second, this strategy allows us to test specific relationships and theoretical assumptions which would be exorbitantly expensive, or practically impossible, to examine at a primary level of analysis. For example, we are able to examine factors, such as amount of training or type of task, that may moderate the effects of mental practice on performance. In this manner, meta-analytic results can provide specific guidelines to the military training designer on how to most effectively implement training (i.e., How many hours of mental practice are required to impact performance? When should refresher training be provided?) By integrating the results of studies of mental practice, overlearning, and other training approaches through the use of meta-analytic techniques, we can not only provide a very accurate estimate of the effectiveness of each of these training approaches, but also identify how they can be most effectively implemented.

C. Research Results:

Research was conducted to examine overlearning, mental practice, stress inoculation training, cohesiveness, team building and relaxation training. Results are briefly discussed below.

The efficacy of overlearning on enhancing performance has been acknowledged by researchers within the training community for years, and this approach has been implemented in several military applications. In spite of this general consensus, there is little summary data on the effectiveness of this technique, nor are there specific guidelines on how to implement overlearning

(i.e., what degree of overlearning is required to enhance performance, how long the beneficial effects of overlearning are retained over time, etc.) Results of our analysis indicated that overlearning is an effective means for enhancing retention for both physical and cognitive tasks. Furthermore, the results of this analysis produced practical guidelines for implementing overlearning in operational settings. For example, results revealed that (a) the increase in retention due to overlearning dissipates after approximately 5-6 weeks, therefore maintaining optimal performance requires that additional training take place on a relatively short-term (3-4 week) schedule, (b) this decay is less evident for physical tasks, thus there may be considerable practical value in ensuring active, physical practice of skills during training, and (c) the increased initial costs associated with overlearning may be partially offset by lowered costs for subsequent retraining or refresher training.

Mental practice refers to the symbolic rehearsal of an activity in the absence of overt physical performance. A recent National Research Council report on training techniques concluded that "the available research on mental practice is consistent enough to support a recommendation for the Army to conduct evaluation studies on operational military tasks" (Druckman & Swets, 1988, p. 70). However, a number of questions arise regarding this technique: Some argue that the effectiveness of mental practice is limited to cognitive tasks, some claim that previous experience with the task is a prerequisite for the effective use of mental practice, and others argue that "too much" mental practice can have negative effects. Results of our analysis revealed that mental practice is an effective means for enhancing performance, and that the effectiveness of mental practice is moderated by the type of task, the retention interval between practice and performance, and the length or duration of the mental practice intervention.

Unit cohesiveness has been identified by many as the single most important variable in reducing the impact of stress in combat. However, some studies call into question the relationship between cohesiveness and performance. In fact, a recent National Research Council review concluded that of the topics studied, "none shows a larger discrepancy between what we think we know and the existing evidence than that of cohesion" (Druckman & Swets, 1988, p. 133). Results of our analysis indicated that the overall effect of cohesiveness on performance was highly significant and of small magnitude. The effect of cohesiveness on performance was moderated by the type of group (real-world versus artificial groups) and by the dimension of cohesiveness that was operationalized. Furthermore, a meta-analytic cross-lagged panel correlation analysis suggested that the direction of effect is stronger from performance to cohesiveness than from cohesiveness to performance.

Stress inoculation training (SIT) is a cognitive-behavioral approach to stress management that has shown considerable promise; however, a number of questions arise regarding the application of this approach to an applied training environment. For example, stress inoculation training has been implemented primarily as a clinical approach, in a laboratory setting, and often administered on a one-to-one basis by an experienced trainer. Therefore, the applicability of this approach to a more applied training environment, in which training is often administered on a group basis by a non-Ph.D. level trainer, is an important issue. A meta-analysis of the literature on stress inoculation training was conducted to determine the effectiveness of SIT and to identify conditions that may moderate the effectiveness of this intervention. Results indicated that SIT is an effective means for reducing state anxiety, reducing skill-specific anxiety, and enhancing performance under stress. Furthermore, the examination of moderators such as the experience of

the trainer, type of setting in which SIT is implemented, and type of trainee population revealed no significant limitations on the application of SIT to military training environments.

Progressive relaxation training is one of the most commonly used stress reduction techniques in the research literature. However, empirical studies of training effectiveness are equivocal. A meta-analysis of the literature on relaxation training was conducted to determine the overall effects of relaxation training and identify conditions under which relaxation training is most effective. Results indicated that relaxation training has a positive and significant effect on reducing subjective anxiety. Moreover, moderators such as the type of subject population, mode of presentation, and size of the training group revealed that relaxation training is equally effective in a variety of different environments and under different conditions. However, there is a lack of data on the effects of relaxation training on performance. Therefore, although relaxation training may make an individual feel less stressed, trainers should be cautioned that the effects of this approach on task performance are unclear.

Team-building is one of the most frequently used organization development interventions. However, some research reviews have concluded that there is no clear-cut evidence to suggest that team building can improve the performance of individuals or teams. The purpose of this analysis was to integrate the team building literature and examine the relationship between team building and performance. The results demonstrated that the team building intervention improved objective performance of the team and enhanced team members' affective reactions to the team. However, the effects of team building were moderated by a number of important variables. For example, team building was more effective in enhancing team performance for groups of smaller size, it was more effective for managerial than for blue collar work groups, and it was more effective for enhancing performance of newly-formed work groups than for intact work groups.

D. Contributions of this Research:

One unique benefit of this approach is the goal of aggregating and cumulating the results of the large body of research on stress and training effectiveness that has been to a large degree supported and funded by the military services. This approach, in effect, "leverages" the investment in this prior research by comparing, integrating, and interpreting this research to summarize research results and determine high-priority directions for further research and application. Furthermore, the results of this research provide very precise guidelines for implementing stress training to enhance the performance of military personnel.

E. Publications and Presentations:

Publications:

Driskell, J. E., & Salas, E. (Eds.) (in press). Stress and human performance. Hillsdale, NJ: Erlbaum.

Mullen, B., & Copper, C. (1994). The relation between group cohesiveness and performance: An integration. Psychological Bulletin, 115, 210-227.

Driskell, J. E., Copper, C., & Moran, A. (1994). Does mental practice enhance performance? Journal of Applied Psychology, 79, 481-492.

- Mullen, B., Anthony, T., Salas, E., & Driskell, J. E. (1994). Group cohesiveness and quality of decision making: An integration of tests of the groupthink hypothesis. Small Group Research, 25, 189-204.
- Driskell, J. E., Willis, R., & Copper, C. (1992). Effect of overlearning on retention. Journal of Applied Psychology, 77, 615-622.
- Driskell, J. E., & Salas, E. (1992). Military psychology. In T. N. Dupuy (Ed.), International military and defense encyclopedia. Washington, DC: Pergamon.
- Saunders, T. Driskell, J. E., Hall, J., & Salas, E. (1995). The effect of stress inoculation training on anxiety and performance. Manuscript under review.
- Driskell, J. E., and Miller, L. A. (1994). Stress and relaxation training: A meta-analytic review. Manuscript under review.

Presentations:

- Driskell, J. E., & Salas, E. (1995). A meta-analytic integration of stress training approaches. Paper presented at the annual meeting of the American Psychological Association, New York.
- Driskell, J. E. (1994). The application of behavioral science to real-world problems. Symposium presented at the American Association for the Advancement of Science, San Francisco.
- Miller, L. A., & Driskell, J. E. (1994). The effect of relaxation training on anxiety. Paper to be presented at the annual meeting of the American Psychological Association, Los Angeles.
- Driskell, J. E., Copper, C., & Moran, A. (1993). Does mental practice enhance performance? Paper presented at the annual meeting of the American Psychological Association, Toronto.
- Saunders, T., Driskell, J. E., Hall, J., & Salas, E. (1993). The effect of stress inoculation training on anxiety and performance. Paper presented at the annual meeting of the American Psychological Association, Toronto.
- Mullen, B., Anthony, T., Salas, E., & Driskell, J. E. (1993). Group cohesiveness and quality of decision making. Paper presented at the annual meeting of the Society for Industrial and Organizational Psychology, Toronto.
- Kaufmann, B., & Mullen, B. (1993). The presence of others and arousal: An integration. Paper presented at the annual meeting of the Eastern Psychological Association, Arlington, VA.
- Driskell, J. E., Mullen, B., Willis, R., & Copper, C. (1991). The effect of overlearning on retention. Paper presented at the annual meeting of the American Psychological Association, San Francisco, CA.